Tests
D-2
Chem. 30
Aug., 1968

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HIGH SCHOOL AND UNIVERSITY MATRICULATION

EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1968

AUGUST

CHEMISTRY 30

Time — 2 hours.

Total Possible Mark — 192.

Note — DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE DIRECTIONS FOR EACH QUESTION CAREFULLY.

Do not write your name on this booklet.

Mathematical tables may be used.
Slide rules are not permitted.

Page 2A contains the Periodic Table. This page, for convenience, should be torn along the perforation for ready reference when required.

All answers will be machine scored. Record your answers on the separate answer sheet provided. You are to use an ORDINARY HB PENCIL to mark your answers on the answer sheet. Make certain your answer marks are heavy and black. If you change your mind about an answer, be sure to erase the first mark completely. Be sure there are no stray pencil marks on your paper. There should be only one answer marked for each question.

DO NOT FOLD THE BOOKLET.

Write your name and school in the space provided in the separate answer sheet.
Place your answer sheet in the **ANSWER ENVELOPE** in such a way that the **UPPER LEFT-HAND CORNER OF THE ANSWER SHEET** shows through the **SLASHED CORNER** of the answer envelope.

BE SURE TO SEAL THE ENVELOPE.

USE THE ATOMIC WEIGHTS SHOWN IN THE PERIODIC TABLE.

Gas Constant, R = 0.0821 liters-atmospheres per degree-mole.
1 faraday = 96,500 coulombs.

RETURN THIS BOOKLET TO THE PRESIDING EXAMINER.

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CURR HIST

All questions have a value of 2 marks each. In each case select the BEST of the five answers and record your choice on the separate answer sheet provided.

EXAMPLE	ANSWERS	ANSWER SHEET
The formula for sulphuric acid is	A. $H_2S_2O_7$ B. H_2SO_4 C. H_2SO_3 D. H_2SO_2 E. HSO_2	A ☐ B ■ C ☐ D ☐ E ☐

You may use an ORDINARY HB PENCIL to mark your answers on the answer sheet. Make certain that your answer marks are heavy and black. If you change your mind about an answer, be sure to erase your first mark completely. There should be no stray marks on your answer sheet and only one answer marked for each question.

1. The vapor pressure of a liquid depends on the

A. external pressure
B. temperature
C. size of the vessel
D. amount of liquid
E. relative humidity

2. When 2.00 grams of powdered copper was heated with powdered sulphur, 2.51 grams of the sulphide was produced. The formula for the sulphide must be

A. CuS_2
B. Cu_2S
C. Cu_2S_3
D. Cu_2S_5
E. Cu_6S_3

3. When a crystal of solute is added to a super-saturated solution

A. all of the solute precipitates
B. the excess solute separates, leaving an unsaturated solution
C. the excess solute separates leaving a saturated solution
D. the excess solute precipitates leaving a dilute solution
E. the added crystal remains undissolved and no further change takes place

FOR ROUGH WORK

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PERIODIC TABLE

PERIOD	GROUP		TRANSITION ELEMENTS GROUP										GROUP					GROUP 0
	1A	2A	3B	4B	5B	6B	7B	8B			1B	2B	3A	4A	5A	6A	7A	
1											1 H 1.0							2 He 4.0
2	3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
3	11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
4	19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
5	37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc ---	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 132.9	56 Ba 137.3	57-71 See La Series	72 Hf 178.5	73 Ta 181.0	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (210)	85 At ---	86 Rn (222)
7	87 Fr ---	88 Ra 226.0	89-103 See Ac Series															

La Series	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm ---	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Ac Series	89 Ac (227)	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np —	94 Pu —	95 Am —	96 Cm —	97 Bk —	98 Cf —	99 Es —	100 Fm —	101 Md —	102 No —	103 Lw —

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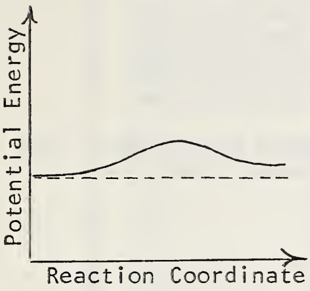
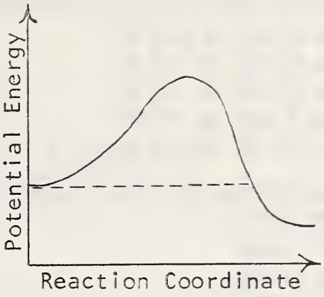
FOR ROUGH WORK

4. Which one of the following would probably be the most rapid endothermic reaction?

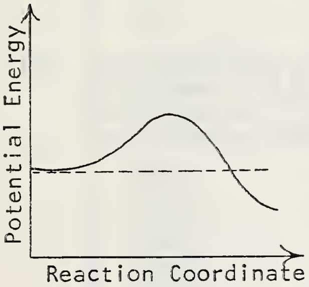
A.



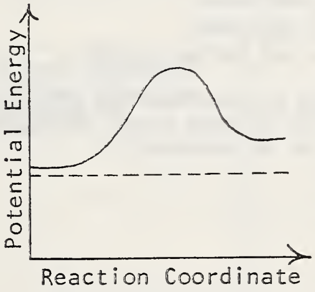
B.



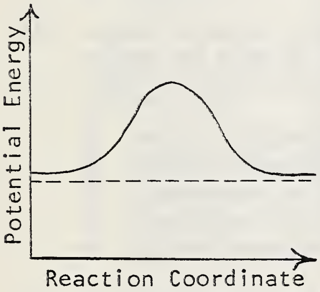
C.



D.



E.



5. Given the following equation:
$SO_2(g) + \frac{1}{2}O_2(g) \rightleftarrows SO_3(g) + 23$ kcal
If 0.20 gram of oxygen gas was used, the amount of heat released would be approximately

A. 0.015 kcal
B. 4.6 kcal
C. 0.29 kcal
D. 0.15 kcal
E. 11.5 kcal

6. The greater the atomic radius

A. the less energy is required to remove a valence electron
B. the less reactive the element will be
C. the greater the ionization energy
D. the more tightly the valence electrons are held by the atom
E. the greater the charge on the ion

FOR ROUGH WORK

7. In one experiment, strips of zinc were placed in different solutions of H_2SO_4. Which of the following produced the smallest decrease in the weight of the zinc, assuming equal times of immersion?

A. zinc strip in 15 ml. of 0.25 M
B. zinc strip in 10 ml. of 0.5 M
C. zinc strip in 10 ml. of 1.0 M
D. zinc strip in 5 ml. of 0.5 M
E. zinc strip in 15 ml. of 1.0 M

8. When the enzyme zymase ferments a sugar, the products obtained are

A. glucose and water
B. fructose and glucose
C. an aldehyde and water
D. ethyl alcohol and water
E. ethyl alcohol and carbon dioxide

9. How many grams of aluminum are deposited when a current of 40 amps passes through an electrolytic cell for 30 minutes?

A. 0.11 gram
B. 0.33 gram
C. 6.7 grams
D. 20.1 grams
E. 27.0 grams

10. How many isomers are possible from the formula C_5H_{12}?

A. 1
B. 2
C. 3
D. 4
E. 5

11. If the burning of methane gas (CH_4) under S.T.P. conditions produces CO_2 and H_2O as products, the volume of O_2 required to burn 100 cm^3 of CH_4 will be

A. 0.10 liter
B. 22.4 liters
C. 0.20 liter
D. 11.2 liters
E. 44.8 liters

12. If a cell constructed of a standard hydrogen electrode as anode and a platinum electrode dipping into a solution of 1M Ce^{+3} and Ce^{+4} ions produced a potential of 1.61 volts, the standard oxidation potential for the half-reaction $Ce^{+3} \leftrightarrows Ce^{+4} + e$ is

A. 1.61 volts
B. impossible to calculate
C. −1.21 volts
D. −1.61 volts
E. either ±1.61 volts depending on whether the reaction reaches equilibrium

FOR ROUGH WORK

13. Each carbon atom in the diamond lattice is bonded covalently to

A. two other carbon atoms
B. four other carbon atoms
C. six other carbon atoms
D. eight other carbon atoms
E. twelve other carbon atoms

14. If the formula hydrogen cyanide is HCN, then the oxidation number of nickel in $Ni(CN)_4^{-2}$ is

A. +2
B. −4
C. −6
D. −2
E. +4

15. A compound when analyzed was found to contain 40% carbon, 6.7% hydrogen and the rest oxygen. If 0.75 liters at S.T.P. weigh 4 grams its true molecular formula is

A. CH_2O
B. CH_3O
C. $C_2H_6O_2$
D. $C_4H_8O_4$
E. $C_6H_{10}O_5$

16. Carbon forms two oxides in which the weight of oxygen per gram of carbon is respectively 1.33 grams and 2.66 grams. This is an illustration of the Law of

A. Definite Composition
B. Multiple Proportions
C. Conservation of Matter
D. Combining Volumes
E. Partial Pressures

17. A solid when melted conducts an electric current. This suggests that it can

A. only be an ionic compound
B. be molecular, covalent, ionic or metallic
C. be molecular, ionic or metallic
D. be only covalent
E. be either an ionic or metallic compound

18. An electric circuit is set up with two cells each receiving the same current. One cell contains silver ions and the other a solution of $Cu(NO_3)_2$. If enough current is passed through the circuit to deposit 107.8 grams of silver metal, the amount of copper metal deposited in the other cell would be

A. 2.0 gram-equivalents of copper
B. 31.77 grams of copper
C. 127.08 grams of copper
D. 63.54 grams of copper
E. 0.5 gram-equivalents of copper

FOR ROUGH WORK

19. The carbon-oxygen bonds in carbon dioxide are highly polar, yet the molecule has no dipole moment. This indicates that the molecule is probably

A. neutral
B. a resonance hybrid
C. linear
D. equiangular
E. ionic

20. The second ionization potential for group IIA elements is greater than the first because

A. the second electron is being removed from a charged ion rather than from a neutral atom
B. the second electron is not in the valence shell
C. the first electron is in a 3p while the second is in a 3s orbital
D. removal of the second electron involves breaking up a stable octet
E. removal of the first electron leads to an inert gas configuration

21. If the formula for a compound were given as A_xB_y, then in one mole of this compound

A. there are x grams of A for y grams of B
B. the valence of element A is x and the valence of element B is y
C. there are x gram-atoms of A and y gram-atoms of B
D. there are Avogadro's number of molecules of A and Avogadro's number of molecules of B
E. there must be Avogadro's number of atoms of A and Avogadro's number of atoms of B

22. The density of one of the oxides of nitrogen is 2.05 gram per liter at S.T.P. The most probable formula for the oxide is

A. NO
B. N_2O_5
C. N_2O_2
D. N_2O_3
E. NO_2

23. Which of the following statements is NOT included in Dalton's atomic theory?

A. All matter is composed of atoms
B. Atoms are composed of electrons, protons and neutrons
C. Atoms may not be subdivided in ordinary chemical reactions
D. All atoms of a particular element are identical
E. Compounds are formed by the union of atoms

24. The binding force in graphite is due to

A. the sharing of electrons only
B. the attraction between positive ions and valence electrons only
C. the attraction between positive ions and negative ions only
D. the covalent bonds and van der Waals forces only
E. coordinate bonds only

25. In a chemical reaction, a catalyst affects

A. the rate of reaction
B. the reaction mechanism
C. the activation energy
D. the quantity of the product
E. all of these

26. Ions in solution and surrounded by water molecules are said to be

A. neutralized
B. hydrogenated
C. dissociated
D. polarized
E. hydrated

27. Nitrogen, chlorine and oxygen react according to the following balanced equation:
$N_2 + 5Cl_2 + 15O_2 \longrightarrow 2N(ClO_3)_5$.
If 8 moles of N_2, 4 moles of Cl_2 and 7 moles of O_2 are mixed, after the reaction, the remaining reactant(s) would be

A. N_2 and Cl_2
B. Cl_2 and O_2
C. N_2 and O_2
D. Cl_2 only
E. O_2 only

28. Given the three reactions:
$Ca_{(s)} + 2H_2O_{(l)} \leftrightarrows Ca^{+2}{}_{(aq)} + 2OH^-{}_{(aq)} + H_{2(g)} + 103 \text{ kcal}$
$CaO_{(s)} + H_2O_{(l)} \leftrightarrows Ca^{+2}{}_{(aq)} + 2OH^-{}_{(aq)} + 19.5 \text{ kcal}$
$H_{2(g)} + \frac{1}{2}O_{2(g)} \leftrightarrows H_2O_{(l)} + 68.3 \text{ kcal}$
The heat of reaction for $Ca_{(s)} + \frac{1}{2}O_{2(g)} \leftrightarrows CaO_{(s)}$ is

A. –15.2 kcal
B. +15.2 kcal
C. +54.2 kcal
D. +151.8 kcal
E. +190.8 kcal

FOR ROUGH WORK

29. The formation of a chemical bond ALWAYS involves

A. loss or gain of electrons
B. transfer or sharing of protons
C. ionization
D. a change in valence
E. attraction of unlike charges

30. If ethyl alcohol is treated with concentrated H_2SO_4, the product is

A. C_2H_5CHO
B. $C_2H_5COC_2H_5$
C. $C_2H_5COOC_2H_5$
D. $C_2H_5OC_2H_5$
E. C_2H_5COOH

31. What volume of 0.2 N H_2SO4 neutralize 25 ml. of 0.06 M NaOH?

A. 4.3 ml.
B. 15 ml.
C. 7.5 ml.
D. 30 ml.
E. 60 ml.

32. A ton atom of carbon would contain (1 lb = 454 grams)

A. $2000 \times 6.02 \times 10^{23}$ atoms
B. 908×10^{25} atoms
C. 120.4×10^{25} atoms
D. 6.02×10^{23} atoms
E. 5.5×10^{29} atoms

33. 0.250 gram of a gas occupies 35 ml. at a pressure of 690 mm. Hg and 27° C. What is the molecular weight of this gas?

A. 1.74
B. 2.55
C. 16.0
D. 194
E. 27.2

34. A liquid is enclosed in a container. Which of the following observations would be true?

A. A condition is reached where the rate of condensation equals rate of evaporation
B. Rate of evaporation increases
C. The temperature of the liquid rises
D. Evaporation continues for a while and then stops
E. The vapor pressure above the liquid becomes equal to one atmosphere

FOR ROUGH WORK

35. On the stock shelf there is a large bottle of 12M HNO_3 and a large bottle of 2M HNO_3. Using only these two solutions and no water the amount of each required to make 300 ml. of 8 M HNO_3 is

A. 200 ml. of 2 M and 100 ml. of 12 M
B. 50 ml. of 12 M and 250 ml. of 2 M
C. 225 ml. of 2 M and 75 ml. of 12 M
D. 75 ml. of 12 M and 225 ml. of 2 M
E. 180 ml. of 12 M and 120 ml. of 2 M

36. Which of the following organic compounds would be LEAST water soluble?

A. $(CH_3)_3 - C - OH$
B. $C_3H_5(OH)_3$
C. $CH_3 - OH$
D. C_8H_{18}
E. $C_4H_9 - OH$

37. When hydrogen gas combines with nitric oxide, water and nitrogen gas are produced. The rate expression of the above reaction is
$\text{Rate} = K[H_2] \times [NO]^2$.
If the concentration of NO is quadrupled, the reaction rate will be

A. quadrupled
B. doubled
C. increased 16 fold
D. increased 6 fold
E. increased 8 fold

38. A cylinder half full of water is fitted with a movable piston. The vapor pressure would be increased by

A. heating the water
B. adding more water
C. pushing in the piston
D. pulling out the piston
E. cooling the water

39. The electronic probability distribution associated with a given energy level is known as

A. a subshell
B. an orbital
C. an orbit
D. a wave function
E. the ionic radius

FOR ROUGH WORK

40. A stream of water molecules can be deflected by a charged rod. This is accounted for by the fact that

A. "s" orbitals repel each other
B. water has a bond angle of 104°31′
C. the ionic bonding produces dissymmetry
D. water molecules are polar
E. oxygen atoms contain more protons than hydrogen atoms

41. It was found in a titration experiment that 14 ml. of NaOH were needed to neutralize 0.93 grams of potassium acid phthalate ($KHC_8H_4O_4$). The molarity of the base would be

A. 0.033 M
B. 3.3 M
C. 0.33 M
D. 1.6 M
E. 0.66 M

42. At a given temperature, it is found that van der Waals forces are strongest when

A. the individual molecules have a small number of neutrons
B. the electrons in the individual molecules are scattered
C. the molecules have a large number of electrons
D. the evaporation point is reached
E. in liquids

43. Which of the following ions will need the LARGEST quantity of electricity to plate out 200 grams of the metal?

A. Cr^{++}
B. Na^{+}
C. Cu^{++}
D. Ag^{+}
E. Ca^{++}

44. A compound is brittle, has a high melting point and dissolves in water to form a conducting solution. It is probably

A. an ionic solid
B. a covalent solid
C. a metallic solid
D. a molecular solid
E. none of the above

FOR ROUGH WORK

45. Dry hydrogen chloride gas is non-corrosive but when this gas is bubbled into water, it becomes extremely corrosive and acidic. This may be explained by the fact that the

A. water splits the hydrogen-chlorine bond to form H^- and Cl^+ ions

B. water splits the hydrogen-chlorine bond to form neutral hydrogen and chlorine atoms

C. water hydrates the hydrogen chloride molecule to form $H^+(aq)$ and $Cl^-(aq)$ ions

D. hydrogen chloride acts as a kind of catalyst to cause more water molecules to break into H^+ and OH^- ions

E. hydrogen chloride causes some of the OH^- ions from normal water dissociation to break into $H^+(aq)$ and $O^{-2}(aq)$ ions

46. A substance which is attracted into a magnetic field is said to be

A. amphoteric

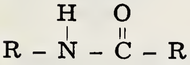
B. paramagnetic

C. diamagnetic

D. isoelectronic

E. electrovalent

47.



$$R-\overset{\overset{\displaystyle H}{|}}{N}-\overset{\overset{\displaystyle O}{\|}}{C}-R$$

The structural formula indicates a class of organic compounds called

A. amides

B. amino acids

C. amines

D. fatty acids

E. proteins

48. In a particular experiment 0.019 moles of methane gas is to be collected over water at 27° C. and a barometer reading of 640 mm. What volume will the methane occupy if we assume complete saturation with water vapor? (Vapor pressure at 27° is 26.7 mm.)

A. 0.38 liter

B. 0.007 liter

C. 0.000063 liter

D. 0.58 liter

E. 0.000066 liter

FOR ROUGH WORK

49. The reaction between water and hydrogen ions to form H_3O^+ ions involves the formation of

A. electrovalent bonds
B. coordinate covalent bonds
C. metallic bonds
D. hydrogen bonds
E. ionic bonds

50. If the average speed of oxygen molecules is 1.0×10^3 miles per hour at S.T.P., the average speed of hydrogen molecules under the same condition is

A. 1.25×10^2 miles per hour
B. 0.25×10^3 miles per hour
C. 8×10^3 miles per hour
D. 4.0×10^3 miles per hour
E. 16.0×10^3 miles per hour

51. The extra amount of energy required to bring about a chemical reaction is known as the

A. dissociation energy
B. collision energy
C. activation energy
D. heat of reaction
E. average kinetic energy

52. The isotope ${}_{56}Ba^{134}$ has

A. 76 electrons
B. 56 neutrons in the nucleus
C. an atomic number of 134
D. 78 neutrons in the nucleus
E. a mass number of 56

53. If the density of bismuth is 9.8 grams per cm^3, the volume occupied by 1.6 gram-atoms is

A. 34.2 ml.
B. 334.4 ml.
C. 15.7 ml.
D. 546.8 ml.
E. 6.1 ml.

54. Ionic bonds will always be formed between elements which

A. differ by less than 8 numbers on the periodic table
B. have bonding electrons in the same sub-orbitals
C. have bonding electrons in different sub-orbitals
D. have a small difference in electronegativities
E. have a large difference in electronegativities

FOR ROUGH WORK

55. Consider these organic compounds:
C_2H_4 , C_3H_6 , C_4H_8 , C_5H_{10} , C_6H_{12} .
They form part of an organic group known as a/an

A. aromatic series
B. cycloparaffin series
C. methane or alkane series
D. ethylene or alkene series
E. acetylene or alkyne series

56. If a liquid molecule is to escape into the vapor state, it must

A. overcome the pressure of the atmosphere
B. have sufficient kinetic energy to overcome the attractive forces in the liquid
C. exert a pressure equal to the vapor pressure
D. be in a state of dynamic equilibrium
E. release some of its kinetic energy to the liquid

57. Organic compounds containing only carbon, hydrogen and oxygen in which the ratio of hydrogen atoms to oxygen atoms is 2 to 1 are called,

A. carbohydrates
B. proteins
C. alcohols
D. ketones
E. esters

58. Which of the following compounds has the most covalent character?

A. CsH
B. MgI_2
C. Mg_3N_2
D. SrS
E. SO_2

59. Use the following standard oxidation potentials for this equation.

$Sn_{(s)} \leftrightarrows Sn^{+2} + 2e$ $\quad + 0.14$ volt
$Ag_{(s)} \leftrightarrows Ag^{+} + e$ $\quad - 0.80$ volt

A cell is constructed using a piece of tin metal dipping into Sn^{+2} ions as one half-cell and a piece of silver dipping into Ag^{+} ions as the other half-cell. If both solutions are IM, which of the following is correct?

A. The cell would deliver +0.66 volt
B. The overall cell reaction would be $2Ag_{(s)} + Sn^{+2} \longrightarrow 2Ag^{+} + Sn_{(s)}$
C. The Ag^{+} ions would be oxidized by the tin metal
D. Sn^{+2} ions would be reduced by the silver metal
E. none of these

FOR ROUGH WORK

60. When two electrons of opposite spin occupy the same orbital they are said to be

A. valence electrons
B. unpaired electrons
C. bonded electrons
D. paired electrons
E. shared electrons

61. The dissolving of potassium chlorate ($KClO_3$) is endothermic. Which of the following statements is FALSE?

A. The more heat added, the greater the solubility of $KClO_3$.
B. Hydration energy in this process is less than the lattice energy
C. The lattice energy is due to solute-solute separation and solvent-solvent separation
D. The lattice energy is greater than the hydration energy
E. Ionization energy and lattice energy are equivalent

62. One would expect the bond in H_2 to be covalent because

A. each hydrogen atom has lost an electron
B. each hydrogen atom has gained an electron
C. the center of positive charge does not coincide with the center of negative charge
D. the two hydrogen atoms have equal attraction for electrons
E. each atom has attained an inert gas configuration

63. In organic chemistry, there is a rule which states that whenever addition takes place at a double bond, the positive part of the reactant adds to the double bond carbon which has the greater number of hydrogen atoms. However, there is a small percentage of the other possible products formed as well. Using this generalization, predict what products would probably be formed when HI is added to $CH_3{-}CH = CH_2$ (propene).

A. 50%-50% mixture of $CH_3{-}CH_2{-}CH_2{-}I$ and $CH_3{-}CH{-}I{-}CH_3$
B. 90% $CH_3{-}CH{-}I{-}CH_3$ and 10% of $CH_3{-}CH_2{-}CH_2{-}I$
C. 90% $CH_3{-}CH_2{-}CH_2{-}I$ and 10% $CH_3{-}CH{-}I{-}CH_3$
D. All $CH_3{-}CH{-}I{-}CH_3$
E. All $CH_3{-}CH_2{-}CH_2{-}I$

64. The formation of a certain compound requires that the number of participating oxygen atoms be 1½ times the number of aluminum atoms. If 20 grams of oxygen is used, the weight of aluminum required is

A. 11.3 grams
B. 22.5 grams
C. 33.8 grams
D. 67.5 grams
E. 50.6 grams

65. Which of the following statements is not consistent with the Kinetic Molecular Theory?

A. There may be a transfer of energy between molecules in a collision
B. The molecules can be thought of as elastic spheres
C. Very little if any kinetic energy is changed to potential energy when gas molecules collide
D. The pressure in a container is due to the kinetic energy the molecules possess
E. The average kinetic energy of all the molecules in a container depends on the number of collisions between themselves and the walls

66. Which of the following reactions would probably have the slowest rate at ROOM temperature?

A. $C_8H_{18}(l) + 12\frac{1}{2}O_2(g) \longrightarrow 8CO_2(g) + 9H_2O(l)$
B. $3Fe^{+2}(aq) + NO_3^-(aq) + 4H^+(aq) \longrightarrow 3Fe^{+3}(aq) + NO(g) + 2H_2O$
C. $5C_2O_4^{-2}(aq) + 2MnO_4^-(aq) + 16H^+(aq) \longrightarrow 10CO_2(g) + 2Mn^{+2}(aq) + 8H_2O(l)$
D. $5Fe^{+2}(aq) + MnO_4^-(aq) + 8H^+(aq) \longrightarrow 5Fe^{+3}(aq) + Mn^{+2}(aq) + 4H_2O(l)$
E. $Cr^{+2}(aq) + Fe^{+3}(aq) \longrightarrow Cr^{+3}(aq) + Fe^{+2}(aq)$

67. Neon is inert because

A. too much energy is required to place electrons in unfilled orbitals
B. electrons must be added to produce stability
C. neon is in group eight of the periodic table
D. it has a completed "s" energy level
E. it has no unpaired electrons

FOR ROUGH WORK

FOR ROUGH WORK

68. When electrical energy is used to break up a compound, it is known as

A. electrolysis
B. ion dissociation
C. protolysis
D. hydrolysis
E. the half-reaction method

69. You are given 2 bags of gas of equal volume and instructed to weigh them at room temperature and pressure. Gas A was found to weigh 7.04 grams and Gas B was found to weigh 0.64 grams. If gas B is known to be oxygen gas, the molecular weight of Gas A will be

A. 35.2 a.m.u.
B. 176 a.m.u.
C. 17.6 a.m.u.
D. 2.92 a.m.u.
E. 352 a.m.u.

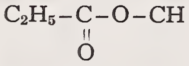
70. A chemist wishes to prepare 240 ml. of 0.5M H_2SO_4. He can do this by

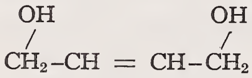
A. taking 20 ml. of 6 M H_2SO_4 and dissolving it in 250 ml. H_2O
B. taking 20 ml. of 6 M H_2SO_4 and adding enough water to make 240 ml.
C. taking 10 ml. of 6 M H_2SO_4 and adding enough H_2O to make 240 ml.
D. dissolving 10.78 grams H_2SO_4 in 240 ml. H_2O
E. dissolving 5.39 grams H_2SO_4 in 240 ml. H_2O

71. A series of tests were performed on an organic compound and the following results were obtained:

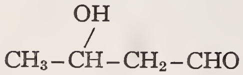
(i) the compound reacts with sodium to form H_2 gas
(ii) the compound reacts with an alcohol to form an ester
(iii) the functional group of this compound is NOT easily oxidized

Which of the following compounds would it likely be?

A. 
$C_2H_5-\underset{\underset{O}{\|}}{C}-O-CH$

B. 

C. $C_2H_4-O-C_2H_3-OH$

D. 

E. C_3H_7-COOH

FOR ROUGH WORK

72. A small piece of calcium is placed in warm water and hydrogen gas is evolved. From this information you could say

A. an electric current flows
B. the piece of metal acquires a slight negative charge.
C. the ionization potential of the metal increases
D. the piece of metal acquires a slight positive charge
E. the ionization potential of the metal decreases

73. Solid elemental sulphur can exist in two crystaline forms. This is a phenomenon known as

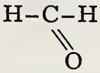
A. cleavage
B. unit cell building
C. multi-crystallization
D. polymorphism
E. Bragg's structuring

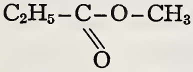
74. The total number of "s" electrons in an atom of the element cobalt is

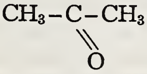
A. 2
B. 4
C. 6
D. 8
E. 10

75. An organic compound gave a brick red color when tested with Fehling's solution. This compound was probably

A. CH_3-CH_2-OH

B.

$H-\underset{\underset{O}{\|}}{C}-H$

C.

$C_2H_5-\underset{\underset{O}{\|}}{C}-O-CH_3$

D.

$CH_3-\underset{\underset{O}{\|}}{C}-CH_3$

E. CH_3-CH_2-COOH

FOR ROUGH WORK

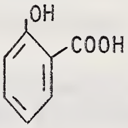
76. Three half-cells are prepared as follows: Aluminum strip in Al^{+3} ions; Cr strip in Cr^{+3} ions and a Ni strip in Ni^{+2} ions. An electrochemical cell made from the Al and Cr half-cells develops 0.92 volt with Al the anode while an electrochemical cell made from the Cr and Ni half-cells develops 0.49 volt with Cr the anode. The expected voltage from an electrochemical cell made from Al and Ni half-cells would be

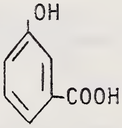
A. +0.43 volt
B. –0.43 volt
C. +1.41 volts
D. –1.41 volts
E. cannot be calculated from this data

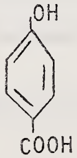
77. One reason why real gases deviate from the gas laws is that

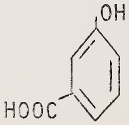
A. the temperatures are high and pressures are low
B. the temperatures are high and pressures are high
C. gas molecules actually have point masses
D. there are attractive forces between molecules
E. the gas laws do not take into consideration the actual number of molecules in a certain volume or the intermolecular distances

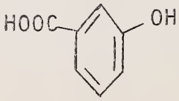
78. Possible structures for salicylic acid are shown below. 1B functional groups are in the ortho position. Which is the correct structural formula?

A.


B.


C.


D.


E.


FOR ROUGH WORK

79. Three test tubes, contain NaBr, NaI, NaCl respectively. Chlorine water and CCl_4 are added to each test tube. Which of the following would be observed?

A. Nothing happened in any test-tube
B. A reaction took place in each test-tube
C. A reaction took place only in the NaI solution
D. A reaction took place only in the NaBr solution
E. A reaction took place in the NaBr and NaI solutions

80. Lower alcohols are liquids at room temperature, but from their small molecular weights, they should be gases. The alcohols are liquids because

A. their molecules exhibit hydrogen bonding
B. have low densities
C. are water soluble
D. are acidic
E. are ionic

81. When an electric current is passed through an aqueous NaCl solution, there is no evidence that sodium is produced at the cathode. The reason for this is thought to be

A. the sodium reacts with water as it is formed
B. the voltage is too high to reduce Na^+ ions
C. H_2O is reduced more easily than Na^+ ions
D. H_2O is oxidized faster and easier than Na^+ ions
E. Cl^- ions are reduced easier than Na^+ ions

82. When ethylamine reacts with an inorganic acid, it forms

A. an ethyl ammonium ion
B. an amino acid
C. an ester
D. a nitrile
E. ammonia gas

83. A certain electrode has a standard oxidation potential that is negative. This electrode

A. cannot be oxidized
B. is a stronger reducing agent than hydrogen
C. will always be a cathode
D. will always be an anode
E. is a weaker reducing agent than hydrogen

FOR ROUGH WORK

84. An organic residue has the following structure:

$R-O-CH_2-CH_2-CH_2-CH_2\cdot$.

This species is called a(an)

A. isoelectric group
B. free radical
C. resonance hybrid group
D. zwitter ion
E. polymorph

85. The number of electrons needed to reduce 4.000 grams of Ca^{++} to calcium metal is

A. 6.02×10^{23}
B. 1.204×10^{23}
C. 96,500
D. 48,250
E. 12.04×10^{23}

86. When proteins are boiled in acidic solutions, they break into

A. carbohydrates and water
B. amides
C. amino acids
D. nitriles and organic acids
E. Zwitter ions

87. The first 20 electrons in the scandium atom ($Z = 21$) are distributed as:

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

Which level does the twenty-first electron occupy?

A. 3d
B. 4p
C. 4s
D. 5s
E. 3f

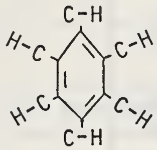
88. Before a chemical reaction can take place, the following condition must exist

A. the activated complex must lose heat of reaction
B. there must be at least one ionic species present
C. colliding molecules must both have energies in excess of the activation energy
D. colliding molecules must have a total energy equal to that of the activated complex
E. the reaction mechanism cannot be more than 3 steps in length

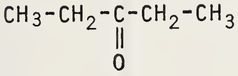
89. Which of the following compounds would likely be the most reactive?

A. $CH \equiv C-CH_2-CH_3$

B.

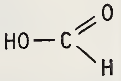


C.



$CH_3-CH_2-C(=O)-CH_2-CH_3$

D.



E. $CH_3-CH=CH_2$

90. This question refers to the following data:

$Hg(l) \rightleftarrows Hg^{++} + 2e$ −0.85 volt
$Fe(s) \rightleftarrows Fe^{+2} + 2e$ +0.44 volt
$Mg(s) \rightleftarrows Mg^{+2} + 2e$ +2.37 volts

When magnesium is placed in cold 1M solutions of $Fe(NO_3)_2$ and $Hg(ClO_4)_2$ we would expect to find the following new product(s)

A. hydrogen gas only
B. Mg^{+2} ions and liquid mercury
C. iron and liquid mercury
D. Mg^{+2} ions, iron and hyrogen
E. mercury and hydrogen gas

91. When excess NH_4OH is added to blue $CuSO_4$ solution, the color of the solution deepens to a dark blue. This is due to the formation of

A. $Cu(NH_4)_4^{++}$ ions
B. $Cu(NH_3)_4^{++}$ ions
C. $Cu(NH_4)_2^{++}$ ions
D. $Cu(NH_3)_2^{++}$ ions
E. $Cu(NH_3)_3^{++}$ ions

FOR ROUGH WORK

FOR ROUGH WORK

Questions 92 through 94 refer to the following data:

A student was given a solution containing some of the following ions. He was required to identify the ions present.

(1) Ag^+ (2) Hg_2^{+2} (3) Al^{+3} (4) Fe^{+3} (5) Ca^{+2}

92. To the solution, 10 drops of 6M HCl was added. No precipitate formed. This indicates the following ions were NOT present.

A. 1 and 3
B. 2 and 5
C. 1 and 2
D. 4 and 5
E. 3 and 4

93. Ammonium hydroxide was added to the original. A precipitate was formed. This indicates the possible presence of

A. 1 and 3
B. 2 and 5
C. 1 and 2
D. 4 and 5
E. 3 and 4

94. To the original solution, 6 M NH_4OH was added, the precipitate that formed was dissolved in 6 M HCl. $K_4Fe(CN)_6$ was then added and a dark blue precipitate was formed. This indicates the presence of

A. 1
B. 2
C. 3
D. 4
E. 5

FOR ROUGH WORK

Questions 95 and 96 refer to the following data:

A student was given a solution containing some of the following ions.

(1) SO_4^{-2} (2) CO_3^{-2} (3) Cl^{-1} (4) I^{-1}

He was required to identify the ions present.

95. Five drops of 0.1M $Ba(NO_3)_2$ was added to the solution. A white precipitate formed. This indicates the possible presence of

A. 1 and 2
B. 2 and 3
C. 3 and 4
D. 1 and 3
E. 1, 2 and 3

96. To the original solution, 5 drops of $AgNO_3$ was added. A precipitate formed which was NOT soluble in excess 6 M MH_4OH. This indicates the presence of

A. 1 only
B. 2 only
C. 3 only
D. 4 only
E. 3 and 4

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[grade 12] 1968, August. --

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